Claims

1. A method for the production of an electronically conducting polymer composite material, comprising:

preparing a dispersion of carbon nanotubes in a solution of one or more polymerisable monomers which upon polymerisation form an electronically conducting polymer; and polymerising the monomer solution to form a unitary polymer mass containing said nanotubes dispersed therein.

2. A method as claimed in Claim 1, wherein the one or more polymerisable monomers are selected from aniline, benzene, furan, pyrrole, thiophene and their derivatives.

3. A method as claimed in Claim 1, wherein the one or more polymerisable monomers are present in the solution at a concentration of 0.1-0.5 M.

4. A method as claimed in Claim 1, wherein the carbon nanotubes are present in the dispersion in an amount of 0.001-1 wt%.

5. A method as claimed in Claim 1, wherein negatively ionised carbon nanotubes are used.

6. A method as claimed in Claim 5, wherein the solvent comprises one or more of water, acetone, acetonitrile,

toluene, methanol, ethanol, dichloromethane, dimethylformamide, dimethylsulphoxide, tetrahydrofuran, propylene carbonate, an ionic liquid or the or a said polymerisable monomer.

7. A method as claimed in Claim 1, wherein non-ionised carbon nanotubes are used.

8. A method as claimed in Claim 7, wherein a charge carrier is dissolved in the solvent.

9. A method as claimed in Claim 8, wherein the charge carrier comprises one or more salts of formula X_aX_b, wherein:
M is selected from H, Li, Na, K, Mg, Ca, Sr, Ba, Cu, Ag, Zn, Fe, Al, tetraalkylammonium; and
X is selected from chloride, bromide, iodide, nitrate, phosphate, sulphate, perchlorate, tetrafluoroborate; biological anions, organicanions, organic polymer anions, or non-stoichiometric anions and
a and b are charge balancing numbers.

10. A method as claimed in Claim 9, wherein the charge carrier salt is present at a concentration of 0.1-0.5 M.

11. A method as claimed in Claim 8, wherein the charge carrier comprises a salt and an ionophore.

12. A method as claimed in Claim 8, wherein the charge carrier comprises one or more charged biomolecules.

13. A method as claimed in Claim 12, wherein the one or more charged biomolecules are selected from amino acids and proteins.

14. A method as claimed in Claim 1, wherein the polymerisation is conducted as an electropolymerisation.

15. A method as claimed in Claim 14, wherein electropolymerisation is conducted at a monomer oxidation potential of 0.7-1.0 V compared with a saturated calomel electrode.

16. A method as claimed in Claim 1, wherein the polymerisation is carried out by allowing said suspension to stand until a gel forms.

17. An electronically conducting polymer/carbon nanotube composite produced by preparing a dispersion of carbon nanotubes in a solution of one or more polymerisable monomers which upon polymerisation form an electronically conducting polymer;
and polymerising the monomer solution to form a unitary polymer mass containing said nanotubes dispersed therein.

18. An electrical energy storage device, comprising:
a first electrode consisting of a first composite of carbon nanotubes and a first electronically conducting

polymer and a first conducting member in contact with the first composite;

a second electrode; and

an electrolyte comprising mobile cations and anions, the electrolyte separating the first and second electrodes and being in contact with the first composite.

19. An electrical energy storage device as claimed in Claim 18, wherein the second electrode consists of a second composite of carbon nanotubes and a second electronically conducting polymer and a second conducting member in contact with the second composite; and the electrolyte is in contact with the second composite.

20. An electrical energy storage device as claimed in Claim 18, where the electronically conducting polymer or polymers are selected independently from polymers or copolymers of aniline, benzene, furan, pyrrole, thiophene and their derivatives.

21. An electrical energy storage device as claimed in Claim 18, wherein the carbon nanotubes are non-ionised.

22. An electrical energy storage device as claimed in Claim 18, wherein negatively ionised carbon nanotubes are used.

23. An electrical energy storage device as claimed in Claim 19, wherein the first and second composites are in the form of thin films on the first and second conducting members respectively.

24. An electrical energy storage device as claimed in Claim 18, rolled into a cylindrical shape with an insulating spacer between the first and second conducting members to form a secondary battery or supercapacitator.

25. An electrical energy storage device, comprising:
a first electrode consisting of a first electrode consisting of a first composite of carbon nanotubes and a first electronically conducting polymer, and a first conducting member in contact with the first composite;

a second electrode; and

an electrolyte comprising mobile cations and anions, the electrolyte separating the first and second electrodes and being in contact with the first composite,

wherein the first electronically conducting polymer has been formed by preparing a dispersion of carbon nanotubes in a solution of one or more polymerisable monomers which upon polymerisation form an electronically conducting polymer; and polymerising the monomer solution to form a unitary polymer mass containing said nanotubes dispersed therein.

26. An electrical energy storage device comprising:
a first electrode consisting of a first electrode comprising a first composite of carbon nanotubes and a first electronically conducting polymer, and a first conducting member in contact with the first composite;

a second electrode comprising a second composite of carbon nanotubes and a second electronically conducting polymer, and a second conduting member in contact with the second composite; and

an electrolyte comprising mobile cations and anions, the electrolyte separating the first and second electrodes and being in contact with the first composite,

wherein the first and the second electronically conducting polymer has been formed by preparing a dispersion of carbon nano-tubes in a solution of one or more polymerisable monomers which upon polymerisation form an electrically conducting polymer; and polymerising the monomer solution to form a unitary polymer mass containing said nanotubes dispersed therein.